C-BAND RADAR BACKSCATTER OF SEA ICE IN THE WEDDELL SEA, ANTARCTICA DURING THE AUSTRAL WINTER OF 1992

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A C-band ship-based scatterometer was used to measure the backscatter coefficient of sea ice in the Weddell Sea during June and July 1992. These are the first microwave scatterometer data ever to be collected in the Antarctic sea ice cover during the austral winter. 'l'he instrument was a frequency-modulated continuous-wave (FM-CW) radar altimeter modified by the University of K ansas Radar S yst ems and Remote Sensing laboratory to perform back scatter measurements. Measurements were taken as part of a Jet l'repulsion laboratory experiment aboard the German ice research vessel F.S. Polar-stern. Backscatter measurements were performed at incidence angles ranging from 17 to 65 degrees with VV and HV polarization as the Polarstern travelled from east to west across the central Weddell Sea. Backscatter measurements were made of several different types of sea. ice including pancake, dark nilas, white nilas, grey, first-year and second-year ice. Periodic external calibrations were performed with the aid of a Luneberg Lens to enable absolute values of backscatter to be derived from the data..

At each radar measurement location, in-situ measurements were made of snow and sea ice. Physical and chemical analyses of ice core and snow samples, together with high magnification photography of snow crystallography provide important information with which to develop physical models of the scattering systems. Met eorological information and oceanographic conditions were also recorded throughout the experiment. Many of the stations were chosen to coincide with periods of near-simultaneous or coincident imaging by the ERS-1 satellite Synthetic Aperture Radar (SAR). This enabled spaceborne imaging by the C-band SAR of areas of sea ice in which backscatter measurements were taken. This provides a valuable tool for interpretation of satellite SAR imagery from Antarctic sea ice in terms of the physical properties of the sea ice and snow. Preliminary results of the backscatter from the various ice types and their relation to the physical properties of sea ice are presented.

Physics] models are developed as a basis for understanding the interaction of microwaves with these Antarctic sea ice media. Using in-situ measurements of the surface roughness and snow and ice properties, predictions from theoretical models are compared with the measurements from typical first-year sea ice. Results of coupling surface scattering models with volume scattering models, based on scattering from spheroidal inhomogeneities in the snow and sea-ice layers, indicate that the primary scattering mechanism under cold mid-winter conditions is surface scattering from the interface between the snow and sea-ice surfs.cc. An important mechanism which serves to modify the physical and chemical appearance of the snow-ice interface is the periodic flooding which has been observed to occur under extreme snow loading, or by deformation of and depression of the ice surface, Results serve to indicate that ERS-1 SAR should be sensitive to such changes in Antarctic sea ice surface as a result of climatic and oceanographic c forcing.